

Prevalence of Ovarian Pathologies in Sheep of Andhra Pradesh: Insights into Reproductive Health

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ABSTRACT

This study investigates the prevalence and characteristics of ovarian pathologies in sheep, focusing on reproductive efficiency's impact on productivity. A total of 212 ovaries from 106 sheep were examined using gross, cytological and histopathological techniques. Of these, 62.26% were normal, while 37.73% exhibited pathological abnormalities, comprising 18.39% neoplastic and 19.34% non-neoplastic conditions. Granulosa cell tumors were the most common neoplastic condition (7.55%), followed by adenomas (4.72%) and hemangiosarcomas (1.89%). Histopathological analysis revealed distinct features, such as Call-Exner bodies in granulosa cell tumors and papillary projections in adenomas. Among the non-neoplastic conditions, follicular cysts were the most prevalent (6.13%), followed by folliculoids (3.77%) and embedded corpus luteum (2.36%). Microscopically, these lesions demonstrated consistent features, such as granulosa cell absence in follicular cysts and fibrous connective encapsulation in embedded corpus luteum. The study highlights significant variations in pathological prevalence between left and right ovaries, with the right ovary more commonly affected. These findings align with existing literature, supporting their diagnostic validity and emphasizing the impact of ovarian abnormalities on reproductive health. By identifying and characterizing these conditions, this research contributes to improved diagnostic accuracy and the development of strategies to enhance reproductive efficiency in small ruminants, ultimately supporting rural livelihoods and food security.

Keywords: Follicular cyst, granulosa cell tumor, ovaries, reproductive efficiency

INTRODUCTION

Livestock production represents one of the fastest-growing agricultural subsectors in developing countries, playing a pivotal role in the economic framework of India¹. Among various livestock categories, small ruminants hold particular importance for ensuring livelihood security, especially for resource-constrained farmers². These animals serve as a viable alternative to crop farming, contributing to subsistence, economic growth, and food security. Indigenous small ruminant breeds, such as sheep and goats are integral to the rural economy, providing multifaceted benefits through products like wool, meat, milk, skins, and manure. Their adaptability to arid, semi-arid and mountainous regions makes them livelihoods of small and marginal farmers as well as landless laborers³.

Sheep and goats have been a cornerstone of Indian farming systems for centuries, offering significant economic and environmental benefits compared to larger livestock species. However, the productivity of these animals is heavily influenced by reproductive efficiency, a critical determinant of successful small ruminant production. Reproductive disorders, including infertility, irregular estrous cycles, abortions, fetal mummification and the birth of weak or stillborn offspring, pose substantial challenges. Without timely diagnosis and effective management, these conditions can escalate into widespread epidemics, adversely affecting herd productivity and economic returns⁴. Early detection and control of reproductive diseases rely on advanced diagnostic methods such as ultrasonography, radiology, laboratory analyses, and abattoir investigations. Abattoir studies are particularly valuable in assessing the reproductive

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health, providing insights into genital tract abnormalities, ovarian cyclicity, and seasonal breeding patterns⁵. This is especially relevant in the context of indiscriminate slaughter practices, which often include gravid animals, due to inadequate ante-mortem examinations. Such practices not only exacerbate prenatal losses but also hinder the ability to meet the growing demand for affordable and high-quality meat⁶. Studies on the female reproductive tract of small ruminants have further highlighted these concerns, revealing a 14.19% prevalence

of ovarian abnormalities, of which 10.48% were neoplastic and the remaining were non-neoplastic⁷.

In Andhra Pradesh, small ruminants play a crucial role in rural livelihoods, yet there is limited data on reproductive wastage, seasonal breeding behaviors, ovarian activity and reproductive tract pathologies. Abattoir investigations provide a vital approach in estimating these losses and addressing the underlying challenges. By identifying and mitigating reproductive inefficiencies, such studies can substantially enhance small ruminant production and thereby contribute to food security in rural communities.

MATERIALS AND METHODS

The study was conducted between June and November 2022. A total of 212 ovaries were collected from 106 sheep of various age groups from slaughterhouses in and around Tirupati, as well as from necropsied animals at the Department of Veterinary

Table 1. Prevalence (%) of various pathological conditions in sheep ovaries.

S. No.	Name of the Pathological Condition	No. of Cases	Prevalence (%)
1.	Granulosa cell tumour	16	7.55
2.	Follicular cyst	13	6.13
3.	Adenoma	10	4.72
4.	Folliculoid	8	3.77
5.	Embedded corpus luteum	5	2.36
6.	Hemangiosarcoma	4	1.89
7.	Lymphangiectasia	4	1.89
8.	Luteinized cyst	3	1.41
9.	Endometriosis	3	1.41
10.	Adenocarcinoma	2	0.94
11.	Fibroma	2	0.94
12.	Clear cell carcinoma	2	0.94
13.	Angioleiomyoma	2	0.94
14.	Cystic corpus luteum	2	0.94
15.	Parovarian cyst	2	0.94
16.	Hemangiopericytoma	1	0.47
17.	Ovarian hypoplasia	1	0.47
18.	Normal ovaries	132	62.26
	Total	212	100

Pathology, College of Veterinary Science, Tirupati, and field mortalities. Necropsies were performed according to standard protocols⁸.

Impression smears were prepared by making incisions on the ovaries, fixing the smears in 70% methanol, and staining them with Giemsa stain for cytological examination⁹. For histological evaluation, the ovaries underwent gross examination, followed by fixation in 10% neutral buffered formalin. After fixation, the tissues were rinsed in running tap water for a specific duration to remove excess fixative, then processed through a graded series of alcohols for dehydration, cleared in xylene and embedded in paraffin. Thin sections (4-5 µm) were obtained using a Leica manual rotary microtome and carefully mounted onto glass slides. The mounted sections were then deparaffinized, rehydrated through a descending series of alcohol concentrations, and stained with hematoxylin and eosin (H&E) following standard protocols¹⁰.

RESULTS

In the present study, a total of 212 ovaries from 106 sheep were examined, regardless of age group or breed. Of the 212 ovaries, 132 (62.26%) were normal, while 80 (37.73%) exhibited various pathological lesions. Among the affected ovaries, 39 (18.39%) were neoplastic and 41 (19.34%) were non-neoplastic conditions (Table 1). The prevalence of pathological lesions varied between the left

and right ovaries depending on the specific condition, but the right ovaries were found more affected (55%) compared to the left ovaries (45%).

Granulosa cell tumor was the most common condition (7.55%), followed by follicular cysts (6.13%), adenomas (4.72%) (Fig. 3), folliculoid lesions (3.77%), embedded corpus luteum (2.36%), hemangiosarcoma (1.89%), lymphangiectasia (1.89%), luteinized cysts (1.41%), endometriosis (1.41%), adenocarcinoma (0.94%), fibroma (0.94%), clear cell carcinoma (0.94%), angioleiomyoma (0.94%), cystic corpus luteum (0.94%), parovarian cysts (0.94%) and the least prevalent conditions were hemangiopericytoma (0.47%) and ovarian hypoplasia (0.47%). Except for follicular cysts (Fig. 1), parovarian cysts (Fig. 2), and hypoplastic ovaries, other conditions did not show any significant gross lesions.

Prevalence of the ovine ovarian neoplastic conditions

This study identified eight distinct neoplastic conditions, comprising one sex cord tumor, three epithelial tumors, and four mesenchymal tumors. Granulosa cell tumors were the most frequent, accounting for 7.55% of cases (Fig. 3). Histopathology revealed the characteristic intrafollicular radial arrangements of tumor cells encircling the central eosinophilic structures, known as Call-Exner bodies. Adenomas were the second most common, representing 4.72% of cases (Fig. 4). Microscopically, two types of adenomatous conditions were observed, cystadenomas in the ovarian stroma

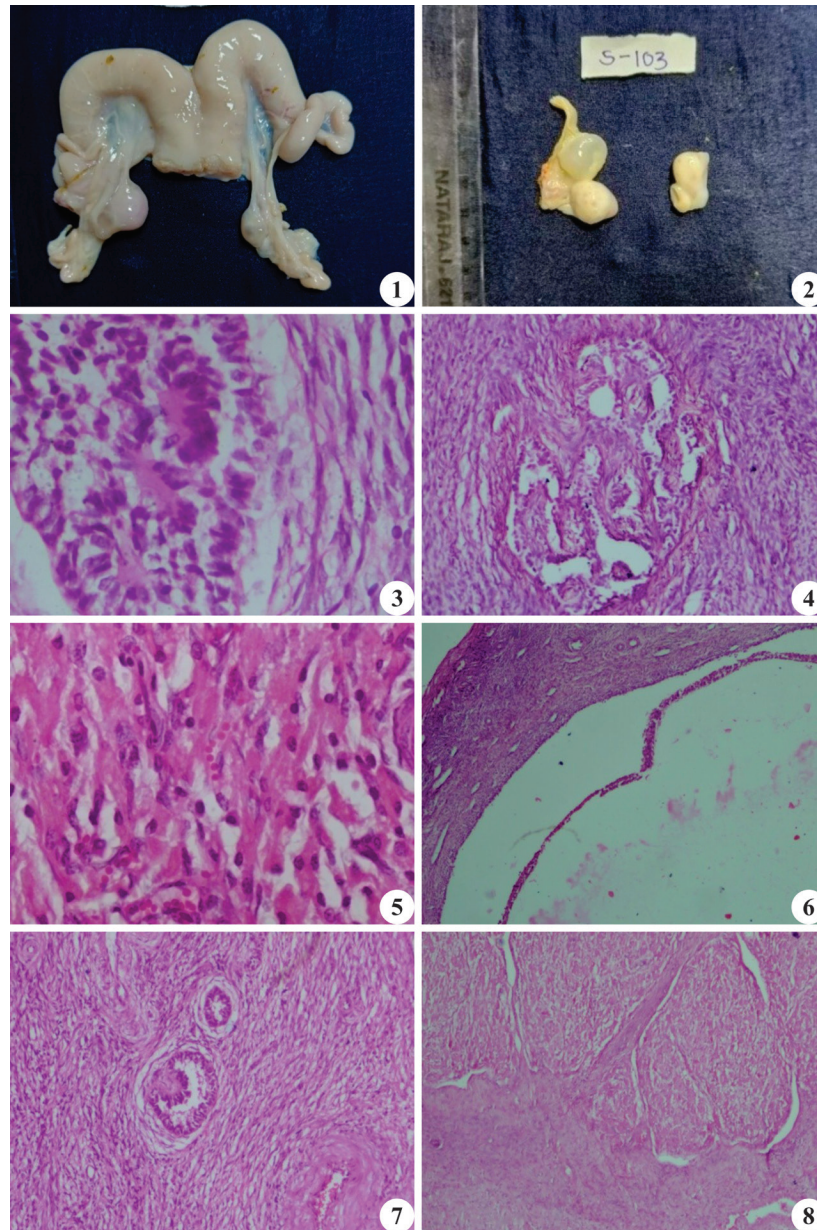


Fig. 1. Follicular Cyst: A thin-walled cyst containing transparent fluid, bulging outward from the surface of the left ovary. This structure often represents an anovulatory follicle, which has failed to rupture and release an oocyte; **Fig. 2.** Parovarian Cyst: A thin-walled cystic structure located near the posterior end of the ovary. Parovarian cysts are non-functional remnants of embryological structures; **Fig. 3.** Granulosa Cell Tumor: Neoplastic granulosa cells forming Call-Exner bodies, arranged in a distinctive rosette pattern around eosinophilic material. Histological staining (H&E x40) highlights these features, which are typical of this ovarian tumor type; **Fig. 4.** Adenoma: Neoplastic epithelial cells project into the cystic space, supported by collagenous fibers. The histological section (H&E x10) reveals a benign tumor commonly seen in the ovarian stroma; **Fig. 5.** Hemangiosarcoma: Vascular endothelial tumour with proliferated endothelial cells form cleft-like structures, supported by thin collagen fibers. Some clefts contain red blood cells (RBCs), while others are devoid of RBCs. (H&E x40); **Fig. 6.** Follicular Cyst: A cyst lined by an extremely thin layer of granulosa cells with a compressed thecal layer. The cystic space is highlighted in the low-magnification histological image (H&E x4); **Fig. 7.** Folliculoid: Structures resembling ovarian follicles found embedded in the ovarian stroma. These folliculoid formations are observed in the histological section (H&E x10); **Fig. 8.** Embedded corpus luteum: Connective tissue fibers traversed into the luteal tissue and divided it into a number of lobes (H&E x10).

and cystadenomas of the rete ovarii. In both conditions, neoplastic cells and collagen fibers projected into the lumen of the cystic spaces, with the cystic walls lined by thick collagenous fibers. Hemangiosarcomas accounted for 1.89% of cases (Fig. 5), characterized histologically

by multifocal areas of proliferated and thickened blood vessels, with undifferentiated endothelial cells infiltrating the ovarian stroma. Hemangiopericytomas that revealed fingerprint appearance of pericyte were the least common neoplasm, with a prevalence of 0.47%.

Prevalence of the ovine ovarian non neoplastic conditions

Among non-neoplastic ovarian conditions, follicular cysts were the most prevalent, accounting for 6.13% of cases. Macroscopically, these cysts appeared as thin-walled, tense structures filled with clear, colorless fluid, measuring 5-8 mm in diameter, and causing ovarian enlargement due to their presence in the cortex (Fig. 1). Microscopically, the cysts lacked ova, with the stratum granulosum either intact, absent, or reduced to a single layer. Desquamated granulosa cells were frequently observed within the cystic lumen (Fig. 6).

The second most common condition was folliculoids, observed in 3.77% of cases. These were characterized by eosinophilic material within follicle-like structures lined by one to two layers of granulosa-like cells. The granulosa-like cells were polygonal, with large, oval to round nuclei, scant cytoplasm, and a colloid-type morphology (Fig. 7).

Embedded corpus luteum was the third most prevalent non-neoplastic condition, observed in 2.36% of cases. Microscopically, it appeared as a thick fibrous connective tissue layer encapsulating the corpus luteum and separating it from the surrounding ovarian stroma (Fig. 8). The least prevalent condition was ovarian hypoplasia, with a prevalence of 0.47% in this study.

DISCUSSION

In the present study, pathological abnormalities were identified in 80 out of 212 ovaries examined from 106 sheep, resulting in an overall prevalence of 37.73%. One study reported a significantly lower prevalence of ovarian pathology in sheep¹¹ compared to our findings, while other cited literature aligns more closely with our results¹². A slightly higher prevalence has also been reported in some studies⁷. These findings suggest a prevalence range of 4.95% to 39.87%, with our study positioned at the higher end of this spectrum. This elevated prevalence may be attributed to the inclusion of aged and infertile sheep, whose genital tracts were collected from slaughterhouses⁷.

Interestingly, the high incidence of abnormalities in the right ovary may be associated with its greater follicular activity compared to the left¹³. Among the pathological conditions observed, neoplastic abnormalities had a prevalence of 18.39%, which is notably higher than the prevalence reported by other researchers^{7,14}. The significant variation in these findings could be attributed to differences in sample populations or environmental factors.

Granulosa cell tumors were the most prevalent neoplastic condition observed, consistent with previous reports highlighting their common occurrence in

ovine ovaries. Microscopically, our findings revealed proliferating neoplastic cells and collagen fibers projecting into the ovarian lumen, with the cystic wall lined by thick collagenous fibers. These characteristics align with descriptions provided by other authors^{15,16}, further affirming the accuracy of our diagnostic observations.

Adenoma emerged as the second most prevalent neoplastic condition in this study, manifesting in two distinct types. The first type of tumor exhibited multibranched papillae that arose multicentrically, often filling the lumen of the cyst. These papillae were covered by a single or multilayered epithelium of columnar or cuboidal cells overlying connective tissue stalks¹⁵. The second type was characterized by proliferated papillae consisting of connective tissue stalks lined by single or multiple layers of cuboidal or columnar epithelial cells¹⁶.

In this study, several less common neoplastic conditions were identified, including adenocarcinoma (0.94%), clear cell carcinoma (0.94%), hemangiosarcoma (1.89%), fibroma (0.94%), angioleiomyoma (0.94%), and hemangiopericytoma (0.47%). These findings are consistent with previously reported microscopic lesions in similar and other domestic species^{15,16,17,18,19}.

Follicular cysts were the most prevalent non-neoplastic condition identified in this study, with a prevalence rate of 6.13%. Some studies reported prevalence rates approximately half of our findings²⁰, while others showed rates with closely comparable figures, supporting the validity of our results¹⁴. Microscopically, the cysts did not contain ova, and the stratum granulosum layer was present. In some cases, however, the stratum granulosum layer was absent. Similar microscopic findings have also been reported by other authors in studies on ewes²¹.

Folliculoid was the second most prevalent non-neoplastic condition with a prevalence of 3.77%. Microscopically, eosinophilic material was present in the follicle-like structure, which was lined by 1-2 layers of granulosa cell like cells and formed colloid type folliculoids^{7,22}.

A total of five cases of embedded corpus luteum were noticed in this study, which had a prevalence rate of 2.36%. A thick fibrous connective tissue layer was observed entrapping the corpus luteum from the surrounding ovarian stroma during histopathological examination²⁴.

In this study, the prevalence of less common non-neoplastic conditions was as follows: luteinized cyst (1.41%), cystic corpus luteum (0.94%), parovarian cyst (0.94%), lymphangiectasia (1.89%), endometriosis (1.41%) and ovarian hypoplasia (0.47%). These conditions were

among the least prevalent. A similar pattern of low prevalence has also been reported in other studies^{12,20}. However, variations in the occurrence of these conditions have been noted among different domestic animals. The microscopic features of these lesions observed in this study align with descriptions in the existing literature, further confirming the consistency of these pathological characteristics across studies^{23,25,26,27}.

In conclusion, this study identified pathological abnormalities in 37.73% of examined sheep ovaries, with granulosa cell tumors as the most common neoplastic condition (18.39%). Variations in prevalence across studies reflect differences in sample populations or environmental factors. Microscopic features aligned with previous reports, confirming consistency in pathological presentations. Findings emphasize the importance of understanding ovarian abnormalities in sheep to improve diagnostic and reproductive health strategies.

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